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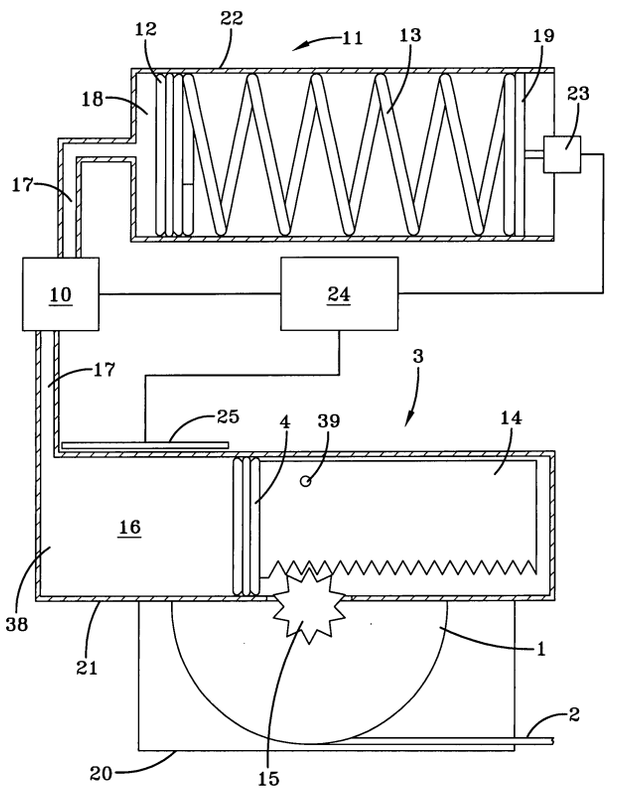
(54) Seat belt retractor

(57) A seat belt retractor, having a belt reel 1 for a seat belt webbing (2) and a load limiter (3) which has a flowable load-limiter medium (16) that is transported through a flow channel, by a displacement device (4) drivable by the belt reel (1), at an energy consumption related to a crash, in which the flow resistance of the transported load-limiter medium (16) in the flow channel (30) or the volume of the load-limiter medium (16) transported in the flow channel (30) per unit time is adjustable.



FIG−1

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Description

[0001] The invention relates to a seat belt retractor in accordance with the preamble of Claim 1.

[0002] A seat belt retractor of this kind, known from DE 199 02 483 A1, has a load limiter, having a flowable medium which is transported, by a hydraulic pump driven by the belt webbing unwound from the belt reel, at an energy consumption related to a crash and adjusted as a function of data related to a crash. The flow of the fluid may be adjusted by a controllable valve.

[0003] The object of the present invention is to provide a seat belt retractor of the type stated at the outset in which the load limiter may be adjusted to the data related to a crash within a short time.

[0004] This object is achieved in accordance with the present invention by the characterising part of Claim 1.

[0005] In the present invention, the flow resistance of the medium transported by the displacement device is adjusted. This adjustment is preferably performed as a function of the seat position and the body weight of the vehicle occupant wearing the seat belt and by the severity of the crash. During the force-limiting withdrawal of the belt webbing, it is possible for a constant or characteristic-controlled belt webbing restraining force to be obtained by adjusting the flow resistance. The flow rate of the transported medium can be adjusted and the desired restraining force from the belt webbing obtained. The corresponding flow resistance and thus the desired flow of the transported load-limiter medium through the hydraulic system of the load limiter may be achieved by a number of embodiments.

[0006] For example, a valve wherein the timing is controlled by an electronic control device and which, as a function of the input parameters relating to a crash, adjusts quantity of the flow of the transported load-limiter medium per unit time may be provided by the timing of opening and closing of the valve.

[0007] The transported medium may be countered by a counter-force that acts over the entire cross-section of the transported load-limiter medium. This counter-force counters the pressure of the transported force-limiter medium and may for example be an adjustable pneumatic spring or a mechanical spring of variable spring force. As a result of this counter-force it is possible to adjust the restraining force from the fastened seat belt webbing.

[0008] The desired flow resistance may be obtained through the cross-section of flow through which the load-limiter medium is transported, and is adjusted automatically responsive to inertia. An inert mass mounted in opposition to a restoring force may be arranged in the flow path and is moved as a function of the acceleration acting in a crash in opposition to the restoring force, in particular spring force to adjust the cross-section of flow responsive to acceleration.

[0009] The mass flow of the transported load-limiter medium may be used as a regulating variable for the restraining force or withdrawal speed exerted by the belt webbing. In the case of a system responsive to mass flow of this kind, an element which is mounted in the flow path in opposition to a restoring force, for example a spring force, and around which the load-limiter medium flows may be provided. This element around which there is flow is moved in opposition to the restoring force by the mass flow of the transported medium, and adjusts the cross-section of flow as a function of the mass flow.

[0010] By altering the viscosity of the load-limiter medium the load-limiting action may be adjusted. Suitable load-limiter media are preferably electrorheological and/or magneto-rheological fluids where the viscosity may be adjusted by an electrical and/or magnetic field. The displacement device may be function in the manner of a hydraulic pump, or such that the displacement device is moved in the load-limiter medium at rest by the force exerted by the belt webbing, in which case the load-limiter medium is transported by the displacement device. The displacement device may be a rotor or in particular as a linearly movable piston.

[0011] In the present invention the space which is available for the forward displacement of the vehicle occupant wearing the seat belt is exploited for force-limited forward displacement. In the case of a large vehicle occupant the restraining force is greater than for a smaller vehicle occupant. This is achieved by adjusting the flow rate or the flow resistance through electronic or electrical or automatic regulation.

[0012] In accordance with a further invention, a hydraulic system having an adjustable flow resistance or adjustable flow rate or the hydraulic system discussed above, forming the force limiter, may also be used to lock the belt reel of the seat belt retractor. A flow barrier is made in the hydraulic system that allows movement of the belt webbing when a minimum pressure is exceeded. When the hydraulic system is blocked, locking of the belt reel is supported at the blocked hydraulic system. This support is provided at least on one side of the seat belt retractor frame. When a minimum pressure is exceeded, a force-limiting movement of the belt reel is permitted, as discussed above, and the flow resistance or the rate (transported volume per unit time) of the force-limiter medium is adjusted accordingly.

[0013] The invention will be explained in more detail with reference to the figures and by exemplary embodiments.

Fig. 1 is a diagrammatic representation of an exemplary embodiment of a seat belt retractor having a load limiter.

Fig. 2 is a diagrammatic representation of the control of the force-limiting action of the exemplary embodiment illustrated in Fig. 1.

Figs. 3 to 7 show exemplary embodiments of an adjustment responsive to acceleration of the cross-section of flow of a fluid force-limiter medium used in the exemplary embodiment of Fig. 1.

Figs. 8 to 10 show exemplary embodiments of adjustment devices responsive to mass flow for the cross-section of flow of the fluid force-limiter medium used in the exemplary embodiment of Fig. 1.
Fig. 11 shows a further construction of the exemplary embodiment.

[0014] Fig. 1 shows diagrammatically a frame 20 of a seat belt retractor on which a belt reel 1 is rotatably mounted. Seat belt webbing 2 may be wounded onto the belt reel 1 and unwound therefrom. To form a load limiter 3 the belt reel 1 is in drive connection with a displacement device 4 which is arranged to be movable in a space closed off in pressure-tight manner, for example a cylinder 21. In the exemplary embodiment illustrated, the displacement device 4 is a piston linearly movable in the cylinder 21. The drive connection with the belt reel 1 is made by a toothed rack 14 fixedly connected to the displacement device 4. The toothed rack 14 meshes with a pinion 15 that is non-rotatably connected to the belt reel 1. Between the toothed rack and the pinion, a gear may also be provided. Instead of the linearly movable displacement device 4, it is also possible for a rotary displacer such as a rotary piston to be provided, in drive connection with the belt reel 1 directly or by a gear. The drive connection between the belt reel 1 and the force limiter 3 is made to ensure in a crash that if there is a forward displacement of the vehicle occupant wearing the seat belt, that there is a force-limited withdrawal of the seat belt webbing 2 from the belt reel 1. The force-limited withdrawal of the belt webbing takes place once a certain force threshold has been exceeded. This force threshold is ensured by a holding device, for example a shearing pin 39. If the restraining force acting on the toothed rack 14 or the displacement device 4 through the holding device (shearing pin 39) is overcome by the force exerted by the belt webbing in the direction of withdrawal, the holding device is detached, that is to say the shearing pin 39 shears off and the belt webbing is withdrawn with force limitation. During this force-limiting withdrawal of the belt webbing, the displacement device 4 is driven over the belt reel 1 by the withdrawn seat belt webbing 2 and moved in the displacement space, for example the cylinder 21. This movement is performed from right to left as seen in Fig. 1. During this, the flowable force-limiter medium 16, for example a hydraulic fluid, is moved from a reservoir space 38 via a transport path 17 and an adjustment device 10 to adjust the volume of load-limiter medium 16 transported per unit time.

[0015] The force-limiter medium 16 is in this case transported into a collecting space 18. The volume of the collecting space 18 may be altered by a piston 12 displaceable in a cylinder 22, as a function of the transported volume of the force-limiter medium 16.

[0016] The force-limiting action 3 may be adjusted as a function of data relating to a crash, by appropriate adjustment of the flow resistance of the transported force-limiter medium 16 and where necessary may be regulated while the belt webbing is being withdrawn in force-limited manner. In the exemplary embodiment illustrated an adjustment device 10 for adjustment of the cross-section of flow and an adjustment device 11 for generation of a counter-force are provided. To adjust the force-limiting action in a manner related to a crash, both adjustment devices 10, 11 may be actuated together or one of the two adjustment devices 10, 11 may be actuated individually.

[0017] The adjustment devices 10, 11 may be triggered together or, as explained, individually by an electronic evaluation unit 24. The electronic evaluation unit 24 evaluates data relating to a crash which contain for exemplary information on the severity of the crash, the seat position and the weight of the vehicle occupant. Measurement data on the severity of the crash may be derived for example from the rotation movement of the belt reel 1, as known for example from DE 199 02 483 A1. The timing of a valve for opening and closing the cross-section of flow can be adjusted appropriately in the adjustment device 10 by the electronic evaluation device 24. The cross-section of opening of the valve can be adjusted. As a result, a certain rate is set at which the force-limiter medium 16 is transported from the reservoir space provided in the cylinder 21 into the collecting space 18.

[0018] The electronic evaluation device 24 may trigger an actuator 23, for example a solenoid or a servo motor, by which the force of a counter-pressure spring 13 is adjusted by a servo element 19. The counter-pressure spring 13 may be a mechanical spring or a pneumatic spring. The counter-pressure spring 13 acts on a counter-pressure piston 12 that delimits the collecting space 18. As a result, the flow resistance of the medium 16 transported in the load limiter 3 may be adjusted. The collecting space 18 then acts as a counter-pressure space in the cylinder 22. The actuator 23 acts on the servo element 19 by which the counter-force of the spring 13 is adjusted.

[0019] Figures 3 to 10 illustrate further exemplary embodiments for the automatic adjustment of the cross-section of flow in the transport path 17 of the displaced force-limiter medium 16. In the exemplary embodiments of Figures 3 to 7 these are flow resistances adjusted in a manner responsive to acceleration, and in the exemplary embodiments of Figures 8 to 10 they are cross-sections of flow adjusted in a manner responsive to mass flow.

[0020] In the exemplary embodiments of Figures 3 to 6, servo elements acting as inert masses m are provided. In the exemplary embodiments of Figures 3 to 6, for the purpose of adjusting the cross-sections of flow these servo elements are acted upon by a restoring force that is a restoring spring 8. In the exemplary embodiments of Figures 3 and 4, servo elements 26 are acted upon by the force of the restoring spring 8 in opposition to an acceleration acting in the direction of the arrow 33. In an acceleration a in the direction of the arrow 33, corre-

sponding to the direction of travel, which overcomes the restoring force of the spring 8, as a result of its inert mass the servo element 26 is moved to the right as seen in Figures 3 and 4, which means that a conically tapering cross-section adjusting part 31 which is connected thereto is pushed into a conically narrowing channel 30 in the flow path of the force-limiter medium 16 transported by the displacement device 4 in a housing 41. The greater the acceleration, the more the cross-section of flow is narrowed in the channel 30. In the exemplary embodiment of Figure 4, a rotor 40 is provided in the channel 30 and consumes energy on its rotation, which is caused by the flowing medium 16. The rotor 40 may be arranged such that it is rotatable about or such that it is on the cross-section adjusting part 31.

[0021] In the exemplary embodiment illustrated in Figure 5, a servo element 27 has an oblique servo ramp 34. In an acceleration a in the direction of the arrow 33 exceeding the restoring force of the restoring spring 8, the servo element 27 is moved to the right as seen in Figure 4 as a result of its inert mass and a cross-section adjusting part 32 is pushed into the channel 30 to narrow the cross-section of flow.

[0022] In the exemplary embodiment of Figure 6, the servo element 28 is spherical. In an acceleration a, acting in the direction of the arrow 33, which exceeds the restoring force of the restoring spring 8, as a result of its inert mass the servo element 28, which at the same time acts as the cross-section adjusting part, is moved into the conically narrowing channel 30 through which the force-limiter medium 16 is transported by the displacement device 4.

[0023] In the exemplary embodiment of Figure 7, in an acceleration acting in the direction of the arrow 33, a servo element 29 is a pendulum is pivoted with pendulum mass m in the direction of the arrow 37 about the pendulum axis 36. As a result, a plunger 35 connected to the upper end is displaced in opposition to the direction of the arrow 37, with the result that the volume of the collecting space 18 is made smaller. As a result, the counter-force which acts in opposition to the direction of flow of the force-limiter medium 16 transported by the displacement device 4 is increased as a function of acceleration.

[0024] In the exemplary embodiments illustrated in the exemplary embodiments of Figures 3 to 7, the flow rate or transportation rate of the force-limiter medium 16 from the reservoir space 38 in the cylinder 21 into the collecting space 18 is adjusted automatically as a function of the severity of the crash by narrowing the cross-section of flow in a manner responsive to inertia or by reducing the volume of the collecting space 18 acting as a counter-pressure space. Thus, the rate of withdrawing the strap of the seat belt webbing 2 from the belt reel 1 is also adjusted accordingly on the forward displacement of the vehicle occupant affected by the crash and wearing the seat belt.

[0025] In the exemplary embodiments of Figures 8 to 10, in each case an element around which there is flow is arranged in the flow path of the force-limiter medium 16 transported by the displacement device 4. The elements around which there is flow are arranged to be movable in the flow path or in the channel 30 in opposition to the restoring force of a restoring spring 9.

[0026] In the exemplary embodiment illustrated in Figure 8, an element 5 around which there is flow has at its rear side a conical shape which can be moved in opposition to the force of the restoring spring 9 into the conically narrowing part of the channel 30. This movement is generated when the pressure difference between the side of flow impact and the rear side of the element 5 around which there is flow exceeds the restoring force of the spring 9. This pressure difference is substantially proportional to the square of the flow rate of the transported force-limiter medium 16. In the exemplary embodiment illustrated in Figure 9, the element 6 around which there is flow is a sphere which is movable in opposition to the restoring force of the spring 9 into the conically narrowing part of the channel 30. In the exemplary embodiment illustrated in Figure 10, the element 7 around which there is flow is a flap valve which may be pivoted in opposition to the restoring force of the spring 9 as a function of the flow rate of the force-limiter medium 16, into the position in the channel 30 shown in dot-and-dash lines.

[0027] To adjust the force-limiting action, a viscosity adjustment device 25 may be provided which is preferably triggered by the electronic evaluation unit 24, as illustrated in Figure 1. The viscosity adjustment device 25 acts on the force-limiter medium 16 from the outside. This action may take place in the reservoir space 38 in which the displacement device 4 acts directly on the force-limiter medium 16. The viscosity adjustment device 25 may be arranged at any other point along the transport path 17 between the reservoir space 38 and the collecting space 18.

[0028] A force-limiter medium 16 suitable for this is an electro- and/or magneto-rheological fluid. By applying an electrical or magnetic field with the aid of the viscosity adjustment device 25 the viscosity of the force-limiter medium 16 is adjusted as a function of the measurement data relating to a crash and evaluated in the electronic evaluation unit 24. As a result of this, it is possible for the flow resistance and the flow rate of the force-limiter medium 16 to be adjusted to the desired value without additional valves or valve controls, on displacement by the displacement device 4.

[0029] In the exemplary embodiments described above, the flowable force-limiter medium 16 is transported through the hydraulic system of the load limiter 3 by the displacement device 4. However, it is also possible for the displacement device 4 to be moved by the flowable force-limiter medium 16 which is at rest in the hydraulic system of the load limiter 3. One or more valves controllable by the electronic evaluation unit 24 may be provided in the displacement device 4. As a result of this

valve control, the flow resistance for the force-limiter medium 16 guided through the moving displacement device 4 or the volume guided through per unit time may be adjusted. When an electro- and/or magneto-rheological fluid is used as the force-limiter medium 16, no valve control of this kind is necessary. By adjusting the viscosity of the force-limiter medium 16, the desired adjustment of the flow resistance is achieved as the medium 16 flows through the moving displacement device 4.

[0030] In the embodiment illustrated in Fig. 11, when the belt reel 1 is locked to prevent further rotation the force required for locking may be supported at the blocked hydraulic system of the force-limiter medium 16. The flow channel for the medium 16 is blocked in the adjustment device 10, constructed for example as a valve device, by a corresponding signal from the evaluation device 24. This may be done if, in excessive acceleration of the vehicle, a control part 45 is pre-blocked by a vehicle sensor 43 of conventional construction and/or a belt webbing sensor 44 of conventional construction. During withdrawal of the belt webbing, an engagement part 48, preferably a latch, is pivoted into the blocking position, in which the engagement part 48 engages in a toothed ring 46 of a toothed ring carrier 47. The engagement part 48 is rigidly connected to an entrainer engaging in the control part 45.

[0031] The toothed ring carrier is non-rotatably connected to the pinion 15 that meshes with the displacement device 4. Because of the incompressibility of the medium 16 and because of the closed hydraulic system, the displacement device 4 and the pinion 15 are supported non-movably at the closed hydraulic system. As a result, the toothed ring carrier 47 and the toothed ring 46 are also supported non-movably at the hydraulic system. The belt reel 1 is thus blocked from further rotation because of the engagement part 48 engaging in the toothed ring 46. When a certain strap withdrawal force is exceeded, the blocked transport of the medium 16 may be released by the adjustment device 10, in which case the flow resistance or the volume of medium 16 transported per unit time is adjusted, as discussed above, to obtain a limited restraining force.

Claims

1. A seat belt retractor, having a belt reel (1) for a seat belt webbing (2) and a load limiter (3) which has a flowable load-limiter medium (16) which is transported through a flow channel, by a displacement device (4) drivable by the belt reel (1), at an energy consumption related to a crash, **characterised in that** the flow resistance of the transported load-limiter medium (16) in the flow channel (30) or the volume of the load-limiter medium (16) transported in the flow channel (30) per unit time is adjustable.

2. A seat belt retractor according to Claim 1, **characterised in that** the force-limiter medium (16) is transportable by the displacement device (4) from a reservoir space (38) into a collecting space (18) of the hydraulic system of the load limiter (3).

3. A seat belt retractor according to Claim 1, **characterised in that** the displacement device (4) is movable in the force-limiter medium (16) which is substantially at rest, with at least part of the force-limiter medium (16) being transported by the moving displacement device (4).

4. A seat belt retractor according to one of Claims 1 to 3, **characterised in that** the cross-section of flow for the transported force-limiter medium (16) is adjustable in a manner responsive to inertia.

5. A seat belt retractor according to one of Claims 1 to 4, **characterised in that** the cross-section of flow is adjustable by a servo element (26, 27, 28) acting as an inert mass and acted upon by a restoring force.

6. A seat belt retractor according to one of Claims 1 to 5, **characterised in that** the servo element (26, 27, 28) is movable in the direction of travel (33).

7. A seat belt retractor according to one of Claims 1 to 4, **characterised in that** the cross-section of flow is adjustable by the mass flow of the transported force-limiter medium (16).

8. A seat belt retractor according to Claim 7, **characterised in that** the cross-section of flow is adjustable by an element (5; 6; 7) around which the transported force-limiter medium (16) flows and which is mounted in opposition to a restoring force.

9. A seat belt retractor according to Claim 6 or 8, **characterised in that** the restoring force is a spring (8; 9).

10. A seat belt retractor according to Claim 1, **characterised in that** the flow resistance or the volume transported per unit time is adjustable by a counterforce acting over the entire cross-section of flow.

11. A seat belt retractor according to one of Claims 1 to 10, **characterised in that** the viscosity of the force-limiter medium (16) is adjustable.

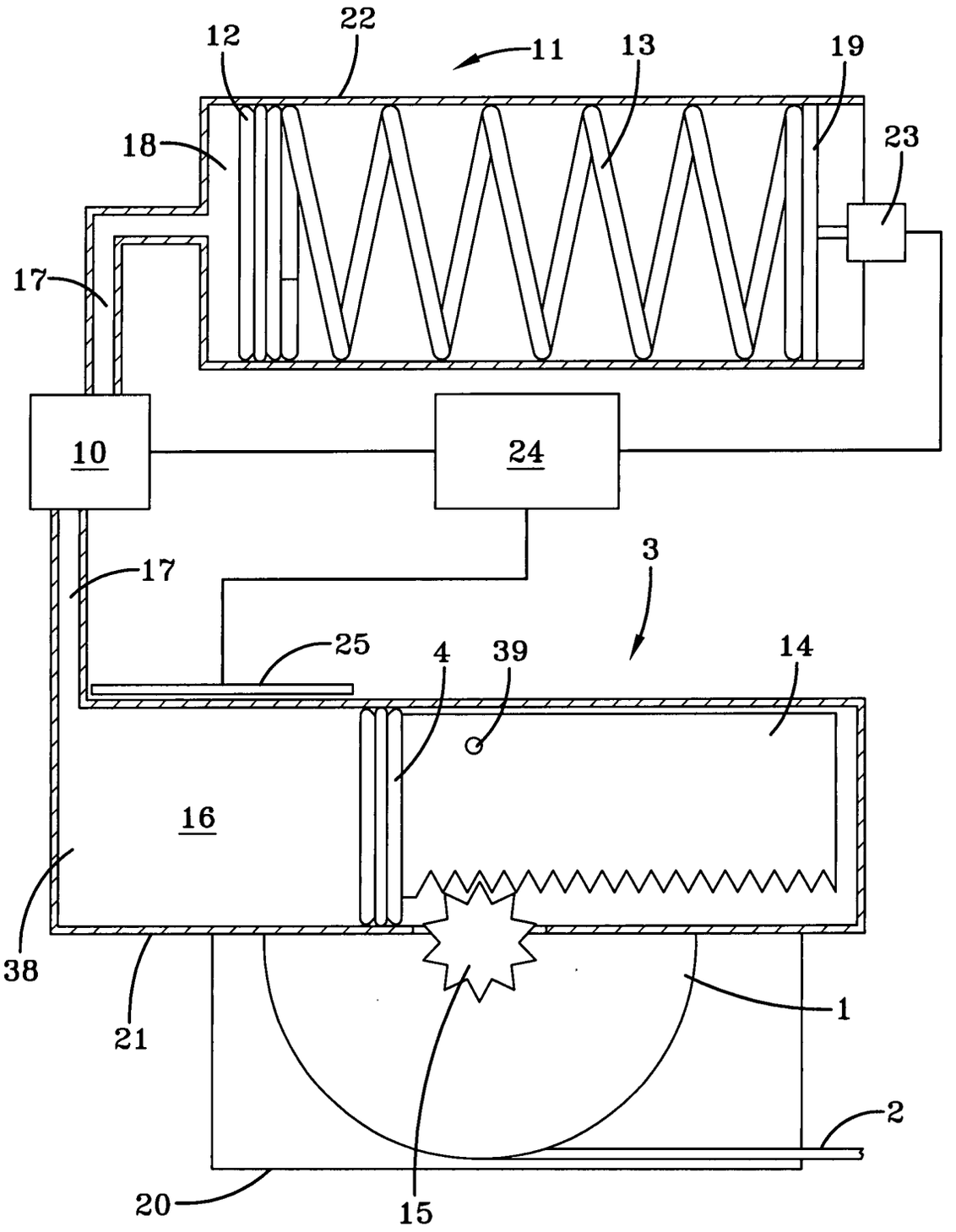
12. A seat belt retractor according to Claim 11, **characterised in that** the force-limiter medium (16) is an electro- and/or magneto-rheological fluid whereof the viscosity is adjustable by an electrical and/or magnetic field.

13. A seat belt retractor according to one of Claims 1 to

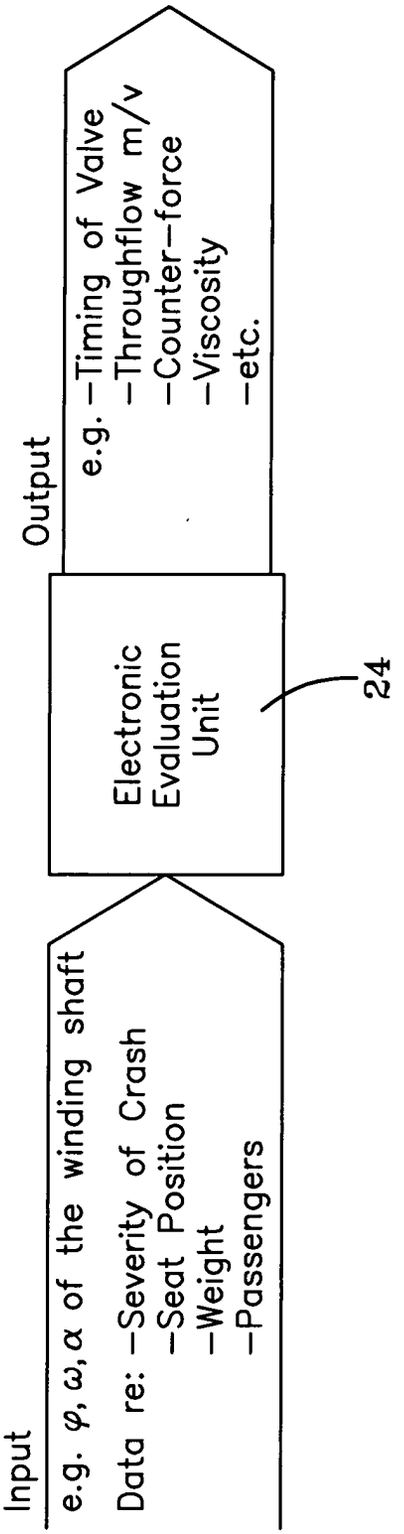
12, **characterised in that** the displacement unit (4) is a linearly movable piston or a rotor.

14. A seat belt retractor, having a flowable medium transportable in a hydraulic system and having a displacement device, in particular according to one of Claims 1 to 13, **characterised in that** the forces occurring when the belt reel (1) is locked are taken up at least partly by the hydraulic system blocked against transport of the force-limiter medium (16).

15. A seat belt retractor according to Claim 14, **characterised in that** the locking device of the belt reel (1) is supported at the displacement device (4).



FIG−1


Input
e.g. φ, ω, α of the winding shaft
Data re: –Severity of Crash
–Seat Position
–Weight
–Passengers
Electronic Evaluation Unit
24
Output
e.g. –Timing of Valve
–Throughflow m/v
–Counter–force
–Viscosity
–etc.

FIG–2

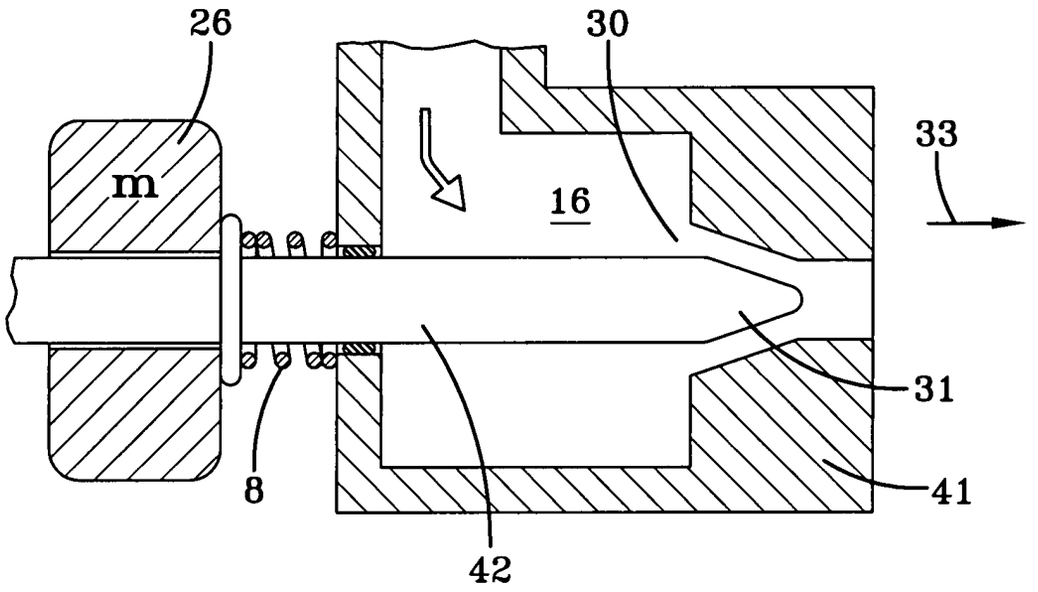


FIG-3

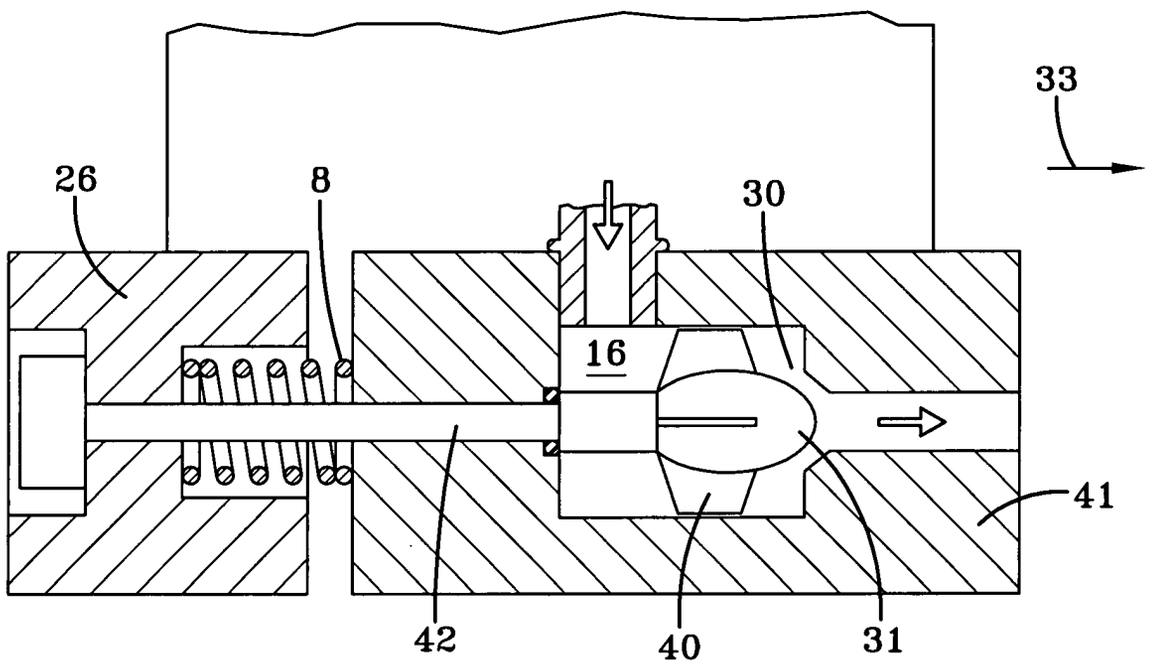


FIG-4

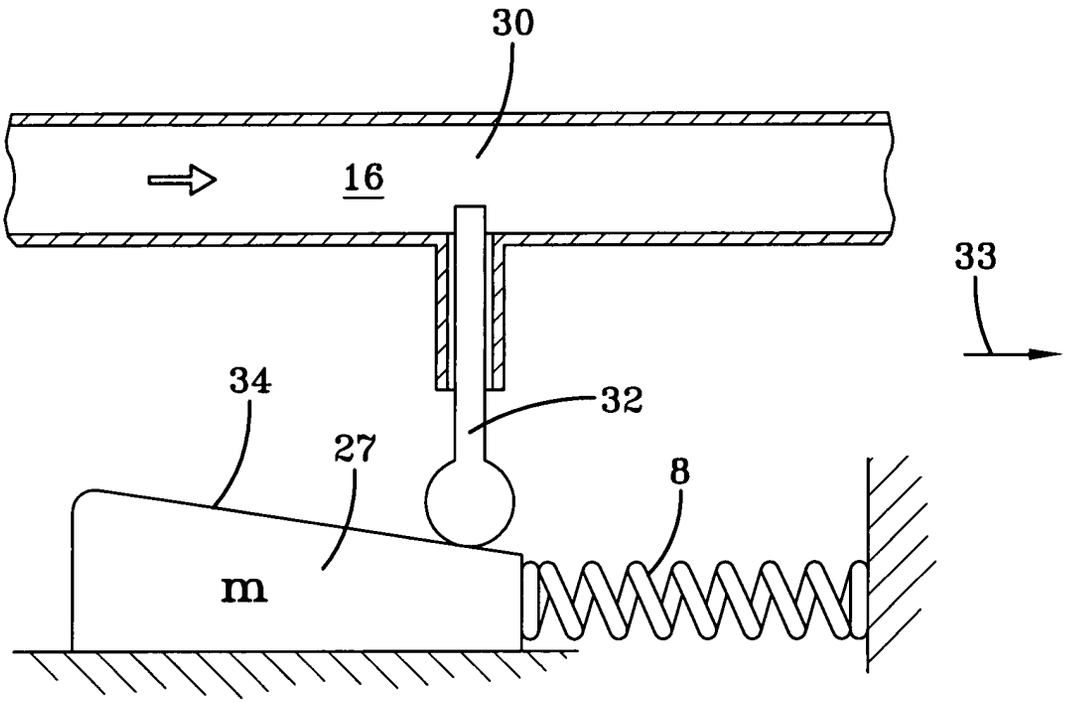


FIG-5

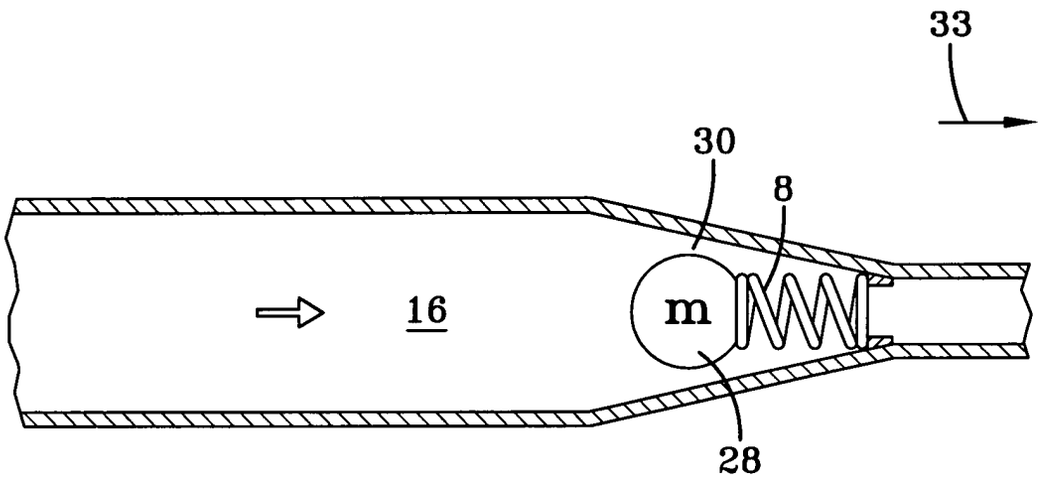


FIG-6

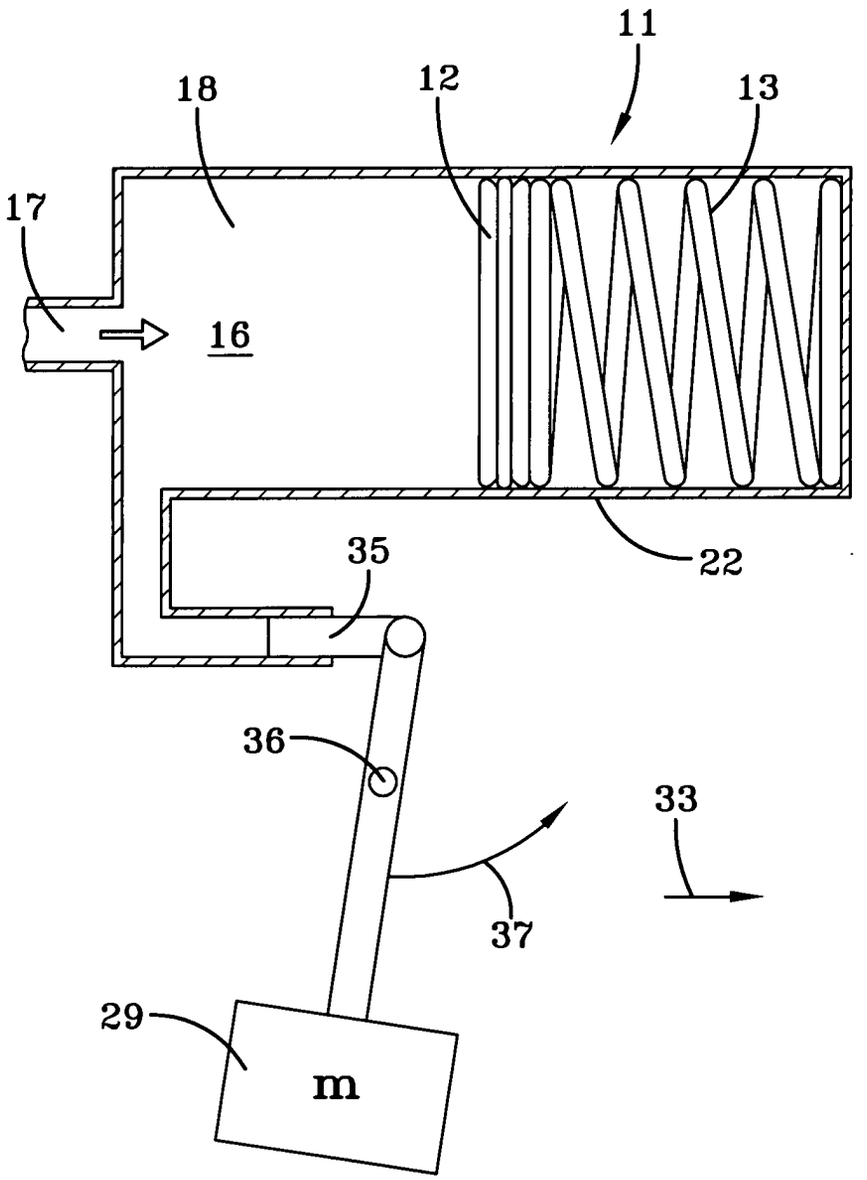


FIG-7

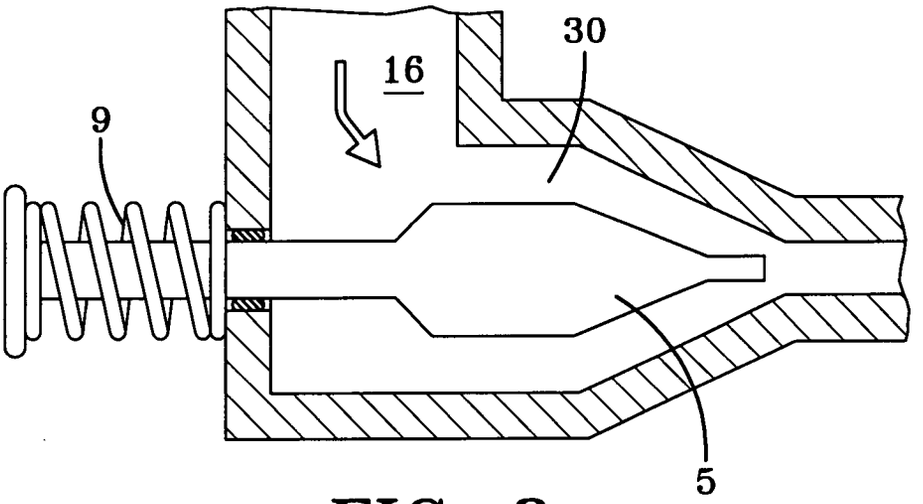


FIG-8

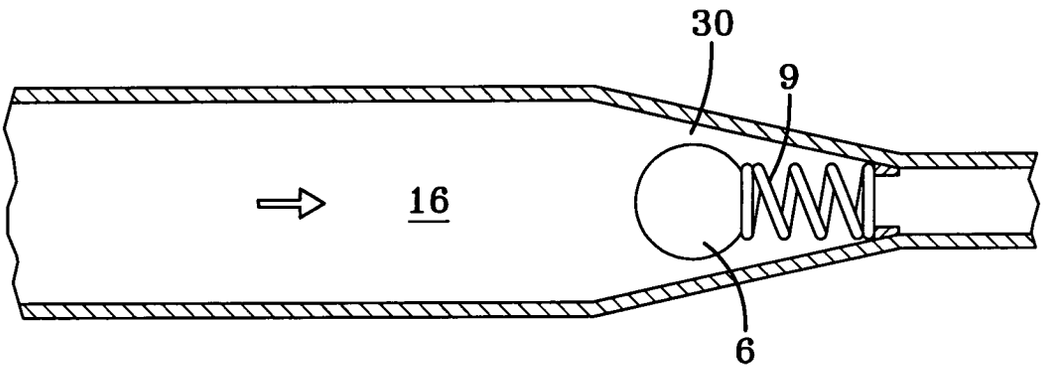


FIG-9

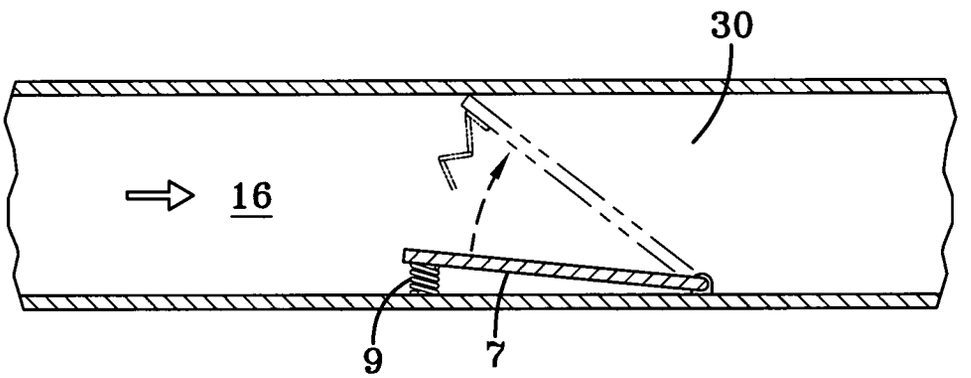


FIG-10

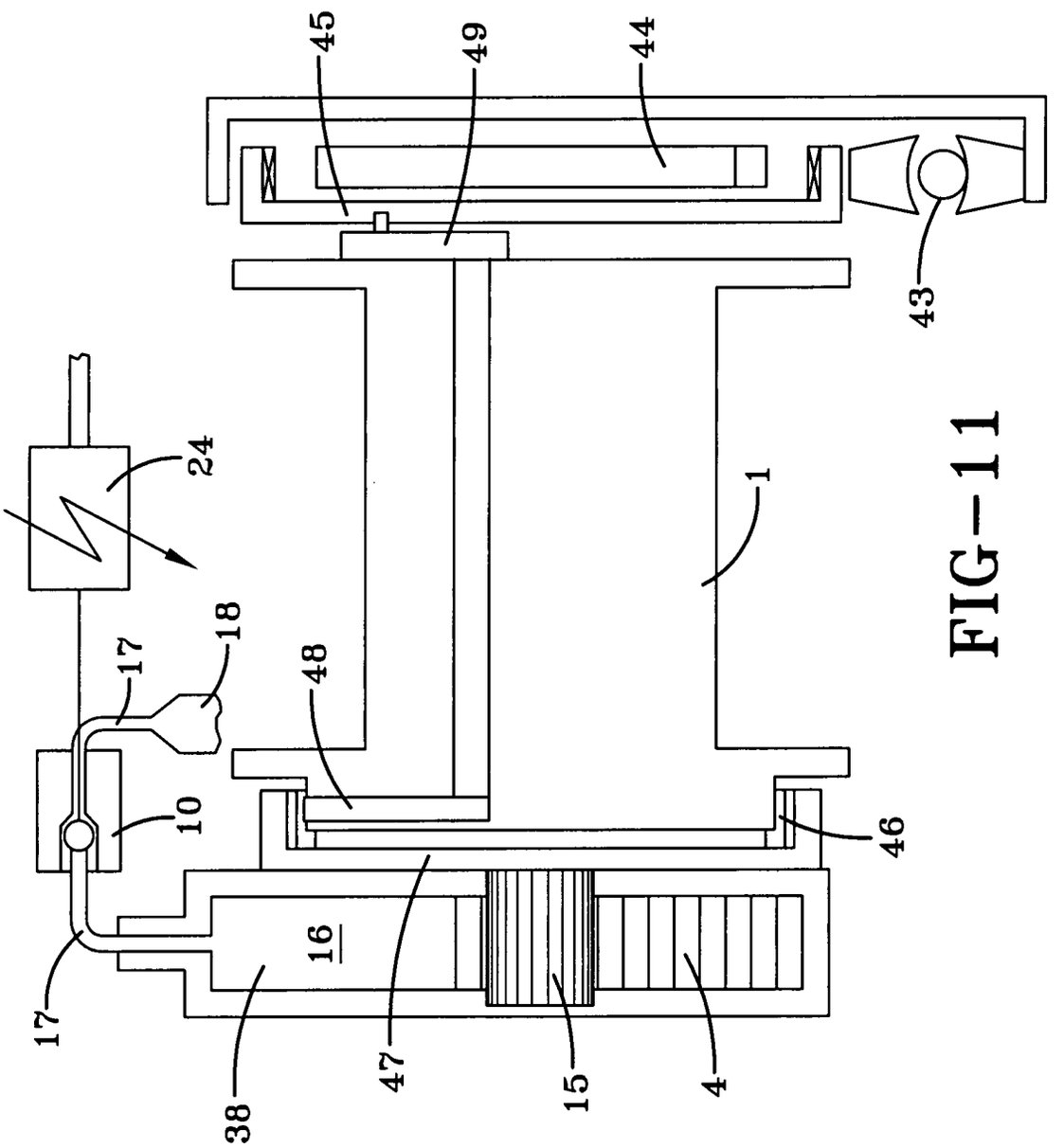


FIG-11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 8343

DOCUMENTS CONSIDERED TO BE RELEVANT

	Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
4	X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 16, 8 May 2001 (2001-05-08) & JP 2001 026252 A (NSK LTD), 30 January 2001 (2001-01-30)	1-3, 11-13	B60R22/34
	Y	* abstract; figures *	4-6,9	
6	Y	US 3 178 136 A (BAYER JACK L) 13 April 1965 (1965-04-13) * column 15, line 4 - line 55; figure 11 *	4-6,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B60R

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
BERLIN	19 November 2002	David, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 (3.82 (P04C01)

European Patent Office

Application Number
EP 02 01 8343

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-6,9,11-13

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 02 01 8343

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-6, 9, 11-13

JP2001026252 A (referred as D1 in the following) discloses (see figures and abstract) a seat belt retractor, having a belt reel for a seat belt webbing W and a load limiter 6 which has a flowable load-limiter medium 62 which is transported through a flow channel 54b, by a displacement device 50 drivable by the belt reel, at an energy consumption related to a crash, wherein the flow resistance of the transported load-limiter medium 62 in the flow channel 54b and therefore the volume of the load-limiter medium 62 transported in the flow channel 54b per unit time is adjustable.

D1 thus discloses the subject matter of independent device claim 1.

D1 discloses also the additional features of dependent claims (see figures and abstract):

2, actually that the force-limiter medium 62 is transportable by the displacement device 50 from a reservoir space 54a into a collecting space 54c of the hydraulic system of the load limiter 6;

3, actually that the displacement device 50 is movable in the force-limiter medium 62 which is substantially at rest, with part of the force-limiter medium 62 being transported by the moving displacement device 50;

11, actually that the viscosity of the force-limiter medium 62 is adjustable;

12, actually that the force-limiter medium 62 is an electro-rheological fluid whereof the viscosity is adjustable by an electrical field 63;

13, actually that the displacement unit is a linearly movable piston 50.

The subject matter of dependent claim 4 differs from the seat belt retractor disclosed in D1 in that the cross-section of flow for the transported force-limiter medium is adjustable in a manner responsive to inertia.

The subject matter of dependent claim 5 differs from the seat belt retractor disclosed in D1 in that the cross-section of flow is adjustable by a servo element acting as an inert mass and acted upon by a restoring force.

The problem corresponding to these special technical

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LACK OF UNITY OF INVENTION
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

features can be seen as how to adapt the cross-section of flow with respect to the deceleration of the vehicle.

Remark: claim 6 has been supposed dependent on claim 5 for clarity reasons (Article 84 EPC) because it mentions the feature "the servo element", feature that has only been introduced in dependent claim 5.

2. Claims: 7, 8

The subject matter of dependent claim 7 differs from the seat belt retractor disclosed in D1 in that the cross-section of flow is adjustable by the mass flow of the transported force-limiter medium.

The problem corresponding to these special technical features can be seen as how to adjust the flow resistance or the volume transported per unit time with respect to the flow itself.

3. Claim : 10

The subject matter of dependent claim 10 differs from the seat belt retractor disclosed in D1 in that the flow resistance or the volume transported per unit time is adjustable by a counter-force acting over the entire cross-section of flow.

The problem corresponding to these special technical features can be seen as how to adjust the flow resistance or the volume transported per unit time by a counter-force acting over the entire cross-section of flow.

4. Claims: 14, 15

The subject matter of dependent claim 14 differs from seat belt retractor disclosed in D1 in that the forces occurring when the belt reel is locked are taken up at least partly by the hydraulic system blocked against transport of the force-limiter medium.

The problem corresponding to these special technical features can be seen as how to lock the reel by blocking the transport of the force-limiter medium.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 8343

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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19-11-2002

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JP 2001026252 A	30-01-2001	NONE	
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82